

# Methodologies for Assessing Agricultural Systems in the Hindu Kush-Himalayas

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## Introduction

During the 1990s mountain development issues came to have a much higher profile on the international development agenda. The Hindu Kush-Himalayan (HKH) region is the largest, most diverse, and possibly the most economically and ecologically important mountain area in the world. This area is undergoing rapid wide-ranging changes, with much of the change coming about in an uncontrolled way. Many people in the rural HKH depend on agriculture for their livelihoods, and many mountain development specialists believe development efforts should focus on harnessing the potential of the great variety of mountain farming niches for developing sustainable agricultural systems. However, planners and policy-makers lack the tools they need to access information on existing systems and potentials, to evaluate changes, and to plan for the management of the agricultural and natural resource base. A methodology that can be used to identify and map mountain farming niches and resources is needed as a basis for planning further action.

Despite the growing awareness of the importance of mountains as global ecosystems, no agency has attempted to systematically map the complexity of their agricultural systems. In 1999, ICIMOD and the International Service for National Agricultural Research (ISNAR) agreed to implement a project under the Eco-regional Fund entitled, 'Methodologies for Assessing Sustainable Agricultural Systems in the Hindu Kush-Himalayan Region: An Eco-regional Framework'. The project, initially planned for three years, began in February 1999 and is one of the second batch of eco-regional projects around the world to support methodological initiatives.

Essentially the project aims to develop, test, and disseminate a methodology for assessing mountain agricultural systems within an eco-regional framework, with a focus on being able to evaluate the sustainability of these systems and thus support sustainable management of mountain agricultural and natural resources. This methodology is actually a set of interactive methodologies, techniques, and models to capture and analyse scaled (spatial/temporal) geo-referenced data sets that provide information on the different types of mountain agricultural systems and associated variability and dynamics.

## MASIF and Land Use Analyst

The basis is a database and information-profiling system called the Mountain Agricultural System Information Files (MASIF). The MASIF database contains georeferenced, relational, time-series data and digital maps covering all aspects related to agriculture, including data related to the natural environment (meteorological, geological, topographical, soil properties, and so on), through land cover and use, crop types and yields, livestock, and demographic patterns. Data are mostly from secondary sources, satellite imagery, and existing maps, and where possible directly verified (ground-truthed). This database can be used to inform scientists

and policy-makers, can provide the rich verified information needed as a control for GIS and rule-based modelling, and can serve as a baseline against which the impact of changes can be measured. It can also provide comparative and training materials, which are useful to link people from areas that are geographically separate but have similar agricultural systems.

The MASIF database is combined with the specially developed Land Use Analyst software to provide an environment based on 'MSAccess' and 'ArcView' software in which time series and spatial data can be combined interactively. MASIF and Land Use Analyst together allow time series data – on, for example, crops, climate, people, and all other variables in the database (separately and combined) – to be shown at any selected scale in map form. Various subroutines are being developed to identify, evaluate, characterise, and delineate the various agricultural systems in the region to assist in planning for sustainable agricultural development. The system can be used to identify mountain agricultural resources, evaluate resource conditions, characterise and delineate agricultural systems, and assist planning for sustainable development. Analyses can be performed from the eco-regional to the local planning unit levels.

The project is working with ICIMOD partner institutions in the HKH to test and refine the methodology, and to develop a collaborative network built around the exchange of information, technologies, and development principles between eco-regions. Three pilot areas were selected to test the system, each representing a major agricultural system in the HKH. These are Kabhre and Sindhupalchowk districts in Nepal's middle hills, representing mixed subsistence crop-livestock systems; Linzhou, Duilongdeqing, Nimu, Damshoing, and Naqu counties in Tibet, China, representing pastoral and agropastoral systems; and Himachal Pradesh, India, representing more commercialised agricultural systems based on horticulture (cash crops).

The project is very concerned to ensure that the system is both usable and used, and training on and dissemination of the methodology is a major objective. Once the software has completed the pilot phase, a concentrated programme of training and publication will make the database and tools available and extend the range of institutional partnerships and links. The methodology is intended to be directly transferable to other mountainous and highland regions of the world such as the Andes and the East African highlands. This will facilitate transfer and extrapolation of knowledge, characterisation of whole mountain ecosystems, and better appreciation of mountains as global ecosystems. Thus the new methodologies and principles will also be disseminated to institutions operating in other mountainous regions of the world.

## **Outputs and Impacts**

Some of the specific outputs are described below.

### ***A methodology for characterising and delineating agricultural systems in mountain areas***

The project has worked on agricultural characterisation using an inverse deterministic approach – in other words concentrating on agricultural outputs like the amount of crops produced – and working backwards to analyse the conditions on the ground that led to them. So far procedures have been developed and tested on a regional scale. First,

information is gathered on reported acreages for all major crops and livestock numbers for a specific year, then crop and livestock production values are estimated and further analysed in terms of total calorie and protein levels, and from this whether the people rely predominantly on crop products, livestock products, or a mixture for their minimum daily requirements. The relative proportions of crop and livestock products form the basis for identification of pure pastoral, mixed crop-livestock, and crop-based agricultural systems. The methodology has been incorporated into both the MASIF database and the Land Use Analyst, giving possibilities for direct use, reference, and comparison with other data and activities on multiple scales. As data are collected for other countries and areas, the approach will be expanded to the whole HKH region and other mountain areas.

### ***Systematic collection of computerised databases on agricultural systems for homologous regions of the HKH***

MASIF was designed as a flexible spatial and temporal georeferenced database, thus enabling compilation and integration of multi-thematic information on agricultural resources on a regional scale. A beta version of the MASIF database has been prepared on CD-ROM for first internal review. At present the database contains georeferenced, relational time series for regional data on crops, livestock, human population, meteorology, land resources, and topographic base maps. When it is complete, the system will enable efficient and effective information exchange of databases among various HKH institutions working in agricultural research, extension, planning, and policy.

### ***A framework for developing methodologies for explorative land use studies for planning and programming in the HKH and for developing mountain-specific policy strategies***

The combined MASIF/Land Use Analyst system is a functional software platform for resource identification, resource evaluation, and agricultural characterisation and delineation. Thus it assists planning for sustainable agricultural development. Various case studies are being carried out to enable further refinement of the software. These include a scaling-down case study on grassland law and rangeland degradation in Tibet (in collaboration with ICIMOD's Rangeland Programme); a scaling-up case study on integrated watershed management experiences for the middle hills of Nepal (in collaboration with ICIMOD's PARDYP); a case study on revised planning for agricultural development in Himachal Pradesh; and image processing and remote sensing (RS) analysis for land cover to land use interpretation.

### ***Collaborative eco-regional network of national collaborating institutions (NCIs)***

Using MASIF as a base, we are building a network of NCIs with a capacity for implementing a national eco-regional framework for mountain agriculture. This is crucial for the success of the Global Mountain Initiative of the Consultative Group for International Agricultural Research (CGIAR) and all mountain research and development projects. Eventually, a well-tested and verified eco-regional methodology will be available that will be able to combine spatial and non-spatial data using GIS/RS technologies for mountainous areas, and will be ready for use in any mountain area in any country. The project has already started training a critical mass of people in applying eco-regional methodology in their own countries.